US-PAT-NO: **4831225**

DOCUMENT-IDENTIFIER: US 4831225 A

TITLE: Microwave oven/convection oven having means for controlling ventilation of the cooking chamber

---------- KWIC ---------

A microwave oven having a heater cooking device, a damper operated by the heat in the cooking chamber to control ventilation to the cooking chamber, a blower for cooling the cooking chamber exterior and electric components such as a magnetron, and **temperature sensor for detecting the cooking chamber internal temperature.** The microwave oven is characterized by a control circuit which actuates the blower immediately when the cooking chamber internal temperature at the time of starting the heater cooking operation is the same as or higher than a specified value considered high enough to actuate the damper and which actuates the ventilator with a delay of a specified time when the cooking chamber internal temperature is lower than the specified value.

4831225

To achieve the above object, according to an embodiment of the present invention, a microwave oven comprises a heater, a

damper operated by the heat in the heating chamber for controlling ventilation to the heating chamber, a blower for cooling the heating chamber exterior and electric components such as a magnetron, **temperature sensor means for detecting the heating chamber temperature,** and control means which actuates the blower immediately when the heating chamber temperature at the time of starting heater cooking operation is the same as or higher than a specified value considered as sufficiently high for actuating the damper and which actuates the blower with the delay of a specified period when the heating chamber temperature is below the specified value.

Referring to FIG. 1, 1 is a control panel having thereon a key for selecting the desired cooking mode from various modes such as heater cooking and microwave cooking, various function keys, numeric keys for setting a cooking temperature and cooking time, a start key for starting a cooking operation and a display. Element 2 is a control device such as a micro processor (MPU) that controls the operation of the microwave oven. Element 3 is a power supply source which controls power supply to a microwave generating device 4 such as a magnetron as heating means for the microwave oven, a heater cooking device 5 and a blower 6 according to a control signal from the control device 2. Element 7 is **temperature sensor means such as a thermistor which detects the heating chamber temperature.** Element 8 is a damper that opens or closes due to

the shape memory effect of a shape memory alloy. When the temperature in the heating chamber rises, the shape memory alloy resumes its memorized shape due to the heat, allowing the damper to close the blowhole provided for supplying ventilating air from the blower 6 to the heating chamber.

It is assumed that heater cooking such as grill cooking in a non-convectional mode or hot-air circulating cooking in a convection cooking mode by an electric heater is selected. When the start key is depressed with the heater cooking mode selected and the cooking time (T) set on the control panel 1, the control device 2 such as a micro processor (MPU) outputs a signal for actuating the heater cooking device to cook food for the preset time (T). Then, the control device 2 makes the **temperature sensor means detect the heating chamber temperature** (K). When the temperature (K) is the same as or higher than a specified value (For example, about 100.degree. C.), the control device 2 sets timer means TIME (countdown timer) for actuating the blower 6 with delay at 0. When the temperature (K) is below the specified value, the control device 2 sets the timer means TIME at a specified value (say 2 minutes) considered necessary for the heating chamber to be heated high enough to close the damper 8. Next, the control device 2 judges whether the setting of the timer means TIME is 0 or not, and outputs a signal for actuating the blower 6 when the setting is 0. Otherwise, it waits for the timer means TIME to count

down to 0 (taking about 2 minutes) before it outputs the signal for actuating the blower 6. By this time, the damper 8 has already closed the blowhole. With this state, heater cooking operation is continued for the preset cooking time (T).

When the cooking time (T) has elapsed, the control device 2 turns OFF the heater cooking device 5 and **detects the heating chamber temperature** (K). When it finds the temperature (K) below the specified value (for example, about 100.degree. C.), it outputs a signal for stopping the blower 6. When the temperature (K) is not lower than the specified value, on the other hand, the control device 2 continues **detecting the heating chamber temperature** (K) until the temperature (K) drops below the specified value, while allowing the blower 6 to keep operating. On **detecting the temperature** (K) below the specified value, the control device 2 performs the blower-stopping routine.

When the heater cooking mode has been selected, the control circuit 9 sends a control signal, in response to the input by the cooking start key, to the heater cooking device 5 to operate it for the preset cooking time. Also in response to the input by the cooking start key, the control circuit 9 controls the **temperature detector circuit 13 so that the temperature sensor means 7 such as the thermistor detects the temperature** in the cooking chamber. The cooking chamber **temperature detected** is sent to the control circuit 9 for comparison

with a reference temperature (H) stored in advance in a memory (ROM) 12. When the cooking chamber temperature is the same as or higher than the reference temperature (H), the control circuit 9 sends a control signal to the blower control circuit 16 to actuate the blower 6. When the cooking chamber temperature is lower than the reference temperature (H), on the other hand, the control circuit 9 reads a specified time (I) stored in advance in the ROM 12 and sets it in a timer 15 for actuating the blower 6 with a delay so that the timer 15 counts down for the specified time (I). The blower 6 stops operation while the timer 15 is counting down.

When the control circuit 9 understands that the cooking timer 14 has counted the preset cooking time, the cooking control circuit 17 works to shut off power supply to the heater cooking device. At this time, the control circuit 9 outputs a control signal to the **temperature detector circuit 13 so that the temperature sensor** means 7 **detects the cooking chamber internal temperature**.

The control circuit 9 compares the **detected temperature** with the reference temperature (H) stored in the ROM 12 . When the **detected temperature** is lower than the reference temperature (H), the blower control circuit 16 works to stop the blower 6, whereas if it is the same as or higher than the reference temperature (H), the blower 6 is allowed to continue operating. In the latter case, the cooking chamber internal **temperature is detected and compared with**

the reference temperature (H) periodically, and when it is judged to be lower than the reference temperature (H), the blower control circuit 16 stops the blower 6.

In the above embodiment, the specified time (I) stored in the ROM 12 is constant independent of the cooking chamber internal temperature. Alternatively, a time value calculated on the basis of the initial temperature in the cooking chamber may be set in the timer 15, or an appropriate specified time (I) may be selected depending upon the **measurement of the cooking chamber internal temperature** from among a plurality of specified times stored in advance for different cooking chamber internal temperatures in the ROM 12.

As described above, in the present invention, the blower is driven in response to the **detection of the temperature** at which the shape of the shape memory alloy spring or the bimetal used in the damper is changed. Therefore, the damper is actuated quickly and accurately by the heat of the heating chamber when the heater cooking is started.

temperature sensing means for sensing the temperature at the interior of said cooking chamber;

control means responsive to selection of said convection cooking mode for **detecting an internal temperature of said cooking chamber according to said temperature sensing means, for comparing said temperature sensing means, for**

comparing said detected temperature to a preset value, and for initiating said countdown timer means;

whereby said blower means blows cooling air at said damper means when said **sensed temperature** is greater than a predetermined value and said predetermined length of time has elapsed according to said countdown timer means.

temperature sensing means for sensing the interior temperature of said cooking chamber; and

5. The microwave/convection oven according to claim 4, further including **temperature sensing means for sensing the interior temperature** of said cooking chamber and timer means for counting down a predetermined length of time upon actuation of said convection cooking mode, wherein said blower means is actuated immediately if said cooking chamber temperature at the time of generating convection cooking energy is equal to or greater than a predetermined temperature and for actuating said blower means after a predetermined delay if said cooking chamber temperature at the time of generating convection cooking energy is less than the predetermined temperature.

219/681